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Research Article

Notes on the phenology of dragonflies and damselflies (Insecta: Odonata) in the Aras River Valley of Türkiye

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Abstract

A check-list of Odonata found at Aras River Valley in Kars and Iğdır provinces of Türkiye is published for the first time, representing 38 species. The abundance of species from March to November is noted by month, with the phenology of the flight period indicated. Summer months host the highest number of species, up to 28 in June. We provide a complete phenology for the imago (adult) presence in the area for 22 species, from their emergence to their disappearance at the end of their flight period and life cycle. Short notes regarding selected species which are either rare in the region or have international protection status are also provided. This study shows that the Aras River Valley is an important place for Odonata, especially *Onychogomphus flexuosus* and *Libellula pontica*, species which are classified as "Vulnerable" and "Near Threatened", respectively, in the present IUCN Red List of threatened species.

Key words: Anisoptera, Aras, flight period, odonate, wetland, Zygoptera

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Introduction

Türkiye is a large, rugged, and diverse country, with habitats ranging from snowy peaks and temperate forests to cold steppes and hot deserts to subtropical coasts. This diversity of habitats is reflected in the diverse fauna of dragonflies (Dijkstra et al. 2020), with the national checklist of Turkish Odonata consisting of 98 species (Boudot et al. 2021). Although the country has a high number of species recorded, the exploration of the country has been uneven, and there is a large potential for odonate research.

The level of past odonatological exploration of Iğdır, Kars, and adjacent provinces is very low. Consequently, since the pioneering work by Kalkman and Van Pelt (2006), only scattered odonate records have been published (see Boudot et al. 2021). However, the dragonfly fauna of the countries bordering eastern Türkiye are comparatively well studied: Armenia (Tailly et al. 2004; Ananian and Tailly 2013), Georgia (Schröter et al., 2015; Seehausen et al. 2016), and Iran (Schneider et al. 2018); see also Boudot et al. (2021).

There has been a long tradition of studying dragonflies—"the"birdwatcher's insect" (see Moore 1957)—at ornithological stations, and this has been carried out in several countries recently (Shapoval and Buczyński 2012; Borisov and Borisov 2016; Knoblauch et al. 2021; Shapoval et al. 2022). The Turkish KuzeyDoğa Society has implemented different nature conservation and research-oriented projects in the Aras River Valley in northeastern Türkiye for the past two decades, including the Aras River Ornithological Research Station (Akküçük and Şekercioğlu 2016). While working at this station, the authors have made observations of dragonflies and damselflies in the area. We aim to increase knowledge of the species diversity of Odonata in this area as well as provide detailed flight period information for each detected species.

Materials and methods

This study was carried out in the northeastern part of the Republic of Türkiye in Iğdır and Kars provinces around the Aras River Ornithological Research Station (40.078°N; 43.358°E), mainly in the vicinities of Yukarı Cıyrıklı and Aşağı Cıyrıklı villages. The Aras River Ornithological Research Station has been operated through the University of Utah and the KuzeyDoğa Society in collaboration with the Koç, Iğdır, and Kafkas universities since 2006 (Şekercioğlu et al. 2011; Neate-Clegg et al. 2019; Kittelberger et al. 2021, 2022). This region is located at the intersection of the Caucasus and Irano-Anatolian biodiversity hotspots (Kittelberger et al. 2022). The study area is situated at an altitude of about 900-1000 m a.s.l. and covers approximately 25 km², including the Aras River Valley and agricultural land from the bridge of D070 road to the dam near Incesu village.

The climate of the study area is continental, with mild winters and hot, dry summers, which is typical for the Eastern Anatolia region. The mean annual precipitation rate is 258 mm (Türkoğlu 2017). The wetland and riparian vegetation of the region primarily consists of a mixture of *Phragmites* and *Typha* spp. among scrub, orchards, and steppe grasslands (Kittelberger et al. 2021, 2022). The banks of the Aras River are partially dammed to prevent the villages and roads from flooding. The bottom of the river is regularly excavated, creating a series of temporary small reservoirs in the dry season. Agricultural land is mainly used for gardening, haymaking, and cattle grazing; therefore, the entire area is riddled with irrigation canals (Fig. 1).

The material for this study was collected across multiple months and years during routine daily work at the Aras River Ornithological Research Station. Some individuals were extracted from the mist nets with a mesh size of 16 mm, identified, photographed, and released. In good weather, places far from the station were visited; of particular interest were flooded fields for growing grass, artificial channels and small lakes with drinking water for cattle, the Aras floodplain terrace, and the surrounding steppe landscape.

Data were gathered by the authors in the following time periods: 11-31 October, 2014 (DK); 01 May – 01 July, 2019 (KDK); 30 August – 20 November, 2021 (KDK); 15 June – 15 November, 2022 (DK); 01 March – 28 April, 2023 (DK); 29 April – 15 June 2023 (KA, GT); 11 Jul – 15 Nov 2023 (KA, GT); 09 March – 27 June, 2024 (DK, KDK, KA, GT).

For the convenience of presenting data on Odonata flight periods, observations were grouped into discrete time periods. Thus, every month was divided

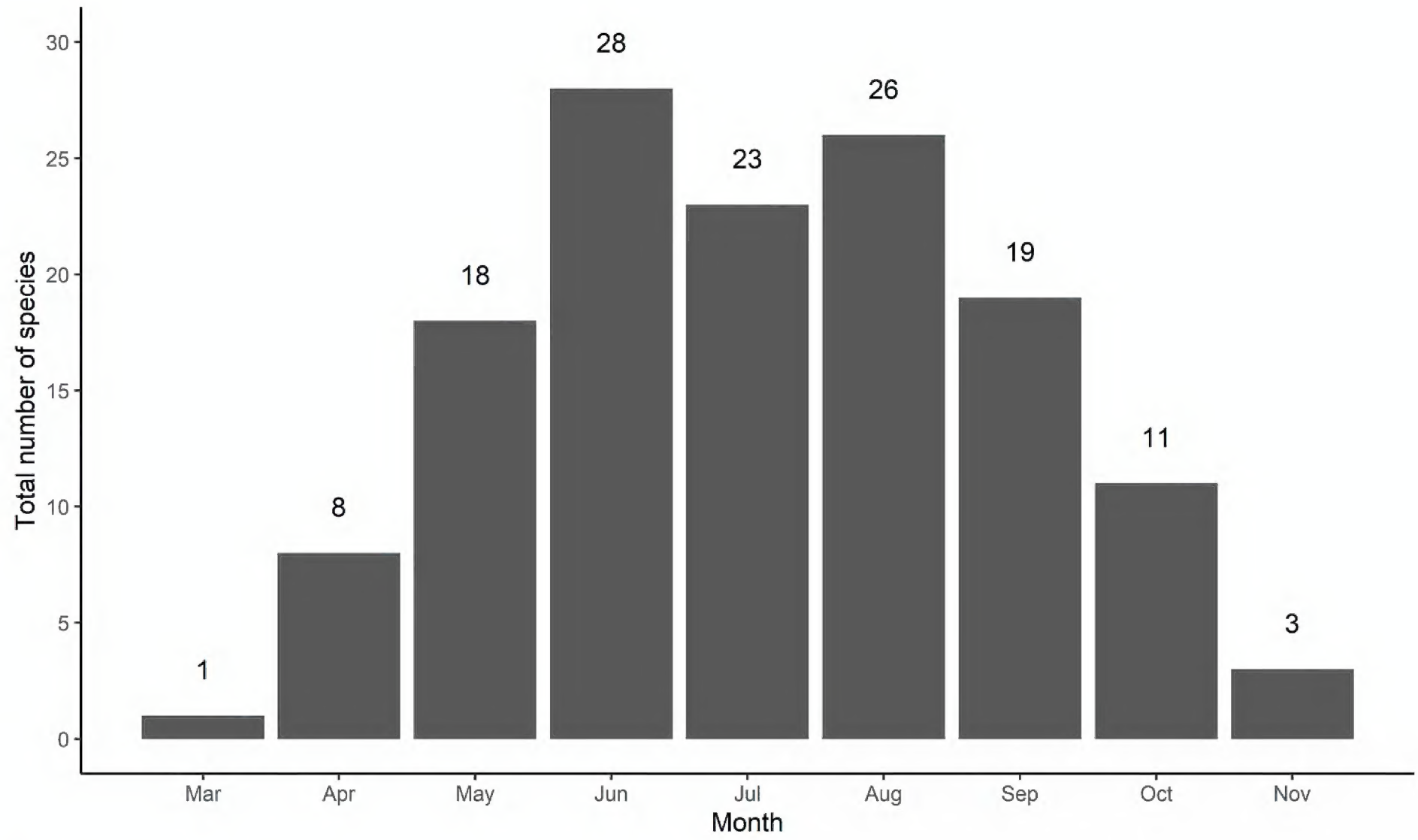
Figure 1. The Aras River Valley in the vicinity of Yukarı Cıyrıklı village (Tuzluca, Iğdir province). Photo by DK on 22 July, 2022.

into 3 periods: I—from 1 to 10 calendar days, II—from 11 to 20 calendar days, and III—from 21 to 30 (or 31) calendar days. The observation of the species during the day was counted as one record, i.e., the maximum number of records a year in periods I and II was 10, and in period III was 11.

Results

In total, 38 species were recorded (Table 1), corresponding to 38.8% of Türkiye's Odonata fauna. The month with the highest species diversity was June, with 28 species recorded, followed by August and July with 26 and 23 species, respectively (Fig. 2). In July, the number of species detected should likely be more than we recorded due to the ornithological station not being in operation during much of the breeding season of many passerine birds, preventing the authors from collecting sufficient data during this period.

Regarding taxonomic groups, 14 species found at the study area belong to suborder Zygoptera, and 24 species to Anisoptera. Among the families detected, 16 species are from Libellulidae; 6 species from families Coenagrionidae and Aeshnidae, respectively; 5 species from family Lestidae; 2 species from family Gomphidae; and 1 species from families Calopterygidae, Epallagidae, and Platycnemididae, respectively.



Figures 2. Monthly occurrence frequency of Odonata species at the Aras River Valley.

Kalkman and Van Pelt (2006) created histograms of the flight periods of dragonflies and damselflies of Türkiye based on 7558 records. Boudot et al. (2021) reveal flight periods for Odonata of Western and Central Asia, including Türkiye, using approximately 37,000 records. Since our analyses are based on relatively short, non-continuous periods of study, we decided to represent our results as a table compiled from 1434 records (Table 1).

For 22 species of Odonata in our study (Table 1), the phenology data from Aras River Valley is complete and contains the beginnings and ends of their flight periods. The longest period of flight is noted in the following species: *Sympecma fusca*, from March (period I) to October (period III), covering two different generations; *Orthetrum brunneum*, from April (III) to October (III); *Sympetrum fonscolombii*, from April (I) to October (I); *Platycnemis dealbata*, from May (II) to October (II); *Ischnura elegans*, from April (I) to September (III); *Ischnura pumilio*, from April (III) to October (II); and *Anax parthenope*, from April (I) to September (III). For 5 species, only the beginning or the end of the flight period is known. Additionally, due to regional habitat limitation or scarceness, further efforts to study the phenology of seven species are needed. Only one observation was available for four species, and so any conclusions on their status and flight period in the region remain premature. The division of dragonfly species according to the degree of their study is presented in Table 2.

Notes on selected species

Sympecma paedisca (Brauer, 1877) (Fig. 3). Two historical records of this species are available for Türkiye (Sélys 1887). This species is known from adja-

Table 1. Flight period of Odonata in the Aras River valley in northeastern Türkiye. Scientific and taxonomic nomenclature follows Boudot et al. (2021). The mark • indicates the time period when there was no data collected but the presence of the species is expected.

Species	№ of records	Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov	
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II
Chalcolestes parvidens	38										2	•	•	•	1	1	1	•	3	6	4	7	8	4	1		
Lestes barbarus	94									4	7	•	•	•	5	11	9	7	11	10	10	10	8	2			
Lestes dryas	1																1										
Sympecma fusca	132	1	6	15	14	19	17	7	9	11	7	•	•	•	2	2	1	4	1	4	4	3	1	3	1		
Sympecma paedisca	1															1											
Calopteryx splendens	48								2	9	7	2	•	•	5	11	8	4									
Epallage fatime	9									1	5	•	•	•	2	•	1										
Enallagma cyathigerum	3										1	•	1	•	•	1											
Coenagrion ornatum	31						2	4	7	11	7																
Coenagrion scitulum	1										1																
Coenagrion puella	5								1	3	1																
Platycnemis dealbata	70								1	11	8	1	2	•	5	11	10	8	9	2	1	•	•	1			
Ischnura elegans	131				1	9	17	6	9	15	8	2	1	•	5	11	7	9	8	9	10	4					
Ischnura pumilio	41						2	1	6	9	2	•	•	•	1	1	2	1	1	6	5	3	•	1			
Aeshna affinis	9														2	1	2	3	1								
Aeshna mixta	83																		10	10	16	15	11	13	6	1	1
Anax ephippiger	9				2	4	2														1						
Anax imperator	12									3	7	1	•	•	•	1											
Anax parthenope	84				3	7	11	7	1	10	8	7	•	•	1	2	4	6	7	2	4	4					

Species	№ of records	Mar			Apr			May			Jun			Jul			Aug			Sep			Oct			Nov	
		I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II	III	I	II
Isoaeschna isoceles	16									3	7	6															
Gomphus schneiderii	3										2	1															
Onychogomphus flexuosus	15												1	•	4	5	3	1	1								
Crocothemis erythraea	14										4	2	•	•	•	•	•	3	3	2							
Libellula depressa	2										2																
Libellula pontica	29								5	11	7	4	•	•	1	1											
Orthetrum albistylum	85							4	4	16	10	8	•	•	5	11	10	8	9								
Orthetrum brunneum	127						1	•	5	12	9	6	•	•	8	11	10	14	13	10	11	8	5	3	1		
Orthetrum cancellatum	2										1	•	1														
Othetrum coerulescens anceps	37									4	5	•	•	•	5	6	5	4	1	3	4						
Pantala flavescens	9										1							2	4	1	1						
Sympetrum depressiusculum	3															1	•	2									
Sympetrum flaveolum	1																		1								
Sympetrum fonscolombii	86				2	9	10	5	2	4	6	•	1	•	1	4	5	5	5	11	10	5	1				
Sympetrum meridionale	37														2	4	3	7	6	7	6	2					
Sympetrum pedemontanum	63										4	•	1	•	5	11	10	10	6	4	6	5	•	1			
Sympetrum sanguineum	41									4	8	4	1	•	3	5	5	7	2	2							
Sympetrum striolatum	55																		2	•	1	9	6	10	12	10	5
Sympetrum vulgatum decoloratum	7																		1	1	•	1	1	•	2	•	1

Table 2. The degree of study of the phenology of dragonflies of Aras River Valley.

The beginning and end of the flight season is known	Only the beginning or the end of the flight season is known	Insufficient data	One record
Chalcolestes parvidens, Lestes barbarus, Sympecma fusca, Calopteryx splendens, Epallage fatime, Platicnemis dealbata, Ischnura elegans, Ischnura pumilio, Aeshna mixta, Anax imperator, Anax parthenope, Onychogomphus flexuosus, Crocothemis erythraea, Libellula pontica, Orthetrum albistylum, Orthetrum brunneum, Orthetrum coerulescens anceps, Sympetrum fonscolombii, Sympetrum pedemontanum, Sympetrum sanguineum, Sympetrum striolatum, Sympetrum vulgatum decoloratum	*Coenagrion ornatum, Coenagrion puella, Aeshna affinis, Isoaeschna isoceles, Gomphus schneiderii*	*Enallagma cyathigerum, Anax ephippiger, Libellula depressa, Orthetrum cancellatum, Pantala flavescens, Sympetrum depressiusculum, Sympetrum meridionale*	*Lestes dryas, Sympecma paedisca, Coenagrion scitulum, Sympetrum flaveolum*

cent Armenia (Ananian and Tailly 2013), which is why Kalkman and Van Pelt (2006) expected it to occur in the eastern part of Türkiye. The only individual in our study was found on 24 July 2022 on a grassy meadow next to a small stream overgrown with vegetation. Targeted searches to clarify its status in the region returned no results, though additional research and further surveys are still needed.

Anax ephippiger (Burmeister, 1839) (Fig. 4). This obligate migratory species migrates northwards from Africa and the Arabian Peninsula between April and mid-June and returns southwards from late August to mid-October (Boudot et al. 2021). One individual was tangled in a mist net on 16 September 2021. In spring 2024 a small shallow lake had been established after a canal had been dammed, and several individuals were seen regularly and later laying eggs, confirming the species to breed (possibly successfully) in the Aras River Valley; emergences and exuviae remain to be found, however.

Onychogomphus flexuosus (Schneider, 1845) (Fig. 5). The IUCN recognizes this species as globally threatened ("Vulnerable") (Kalkman 2020). In Georgia, it is common and widespread in the Mtkvari and Alazani River catchment (Schröter et al. 2015). In Armenia, the most recent observations are from the southeastern part of the country (Ananian and Tailly, 2013). The population in the Aras River Valley seems to be large and stable. This species likely emerges earlier, but from our observations, it is flying from the end of June to the end of August.

Libellula pontica Selys, 1887 (Fig. 6). This species is classified by the IUCN as "Near Threatened" (Kalkman 2006), and it is also protected in Armenia (Ananian 2010), where it was detected in 2011 for the first time since 1964 in the Aras River Valley close to the Turkish border (Ananian 2012). It is common in eastern Georgia, which probably constitutes its main stronghold (Boudot et al. 2021). The species is also common in the Aras River Valley on the Turkish side, where it emerges in the middle of May and flies until the end of July. Many exuviae were found in flooded areas around canals with running water in the agricultural land. It seems that the species avoids the main flow of the Aras River and instead prefers secondary tributaries or even artificial irrigation canals with overgrown vegetation banks.

Pantala flavescens (Fabricius, 1798) (Fig. 7). This species is a strong wanderer and can migrate long distances (Piretta and Assandri 2019; Boudot et al. 2021). From mid to late August, as well as early to mid-September, several individuals, also freshly emerged, were observed. A male patrolling a flooded area to the south of Donandı village was observed on 4 June 2024.

Figures 3. *Sympecma paedisca*, female. Photo by DK on 24 July, 2022.

Figures 4. *Anax ephippiger*, male. Photo by DK on 04 April, 2024.

Figures 5. *Onychogomphus flexuosus*, male. Photo by DK on 17 July, 2022.

Figures 6. *Libellula pontica*, male. Photo by DK on 17 July, 2022.

Figures 7. *Pantala flavescens*, female. Photo by DK on 26 August, 2022.

Figures 8. *Sympetrum depressiusculum*, male. Photo by DK on 21 July, 2022.

Sympetrum depressiusculum (Selys, 1841) (Fig. 8). Kalkman and Van Pelt (2006) do not depict the distribution of this species in the eastern part of Türkiye. Boudot et al. (2021) show more records in the northeastern part of the country, but it is obvious that its range is patchy and poorly known. This species is not recorded in nearby Iran (Schneider et al. 2018). In Armenia, the last published record was before 1963 (Tailly et al. 2004), with no recent records mentioned in the literature (Ananian and Tailly 2013). Few individuals were found at the flooded grass fields near Yukarı Cıyrıklı village on 21 July and 15 and 16 August 2022. Its regional status remains unclear.

Discussion

The results of this study are not comprehensive but provide a reliable basis to continue investigation of the Odonata fauna occurring in the Aras River Valley. Additionally, they provide a baseline and blueprint to study their regional flight period in the context of climate change. Especially, the presence of a bird ringing station facilitates long-term monitoring of odonates, while opportunistic captures via bird mist nets offer subsequent in-hand examination.

Since the Aras River Valley predominantly consists of running water sources, species tied to stagnant water, which are relatively common elsewhere in Türkiye, are local or rare in the study region. For instance, *Libellula depressa* was observed only twice at the study area: presumably a migrating individual at the station and one male defending territory on the small lake near İncesu village. *Othetrum cancellatum* was found only at one location, at a small cattle drinking pond in the steppe (N40.117°, E43.441°); it seems to be a common and numerous species there, but due to the distance of the cattle pond from the bird ringing station, the phenology data is not fully known. The same is true with *Enallagma cyathigerum*, which was also present in good numbers at the same pond but was scarce elsewhere.

The area plays an important role in the preservation of some range-limited or globally threatened species, such as *Libellula pontica* and *Onychogomphus flexuosus* (Kalkman 2006, 2020). Species-oriented efforts are needed in the future, especially with understanding how these species that are associated with river ecosystems might benefit from a ban on river construction or the establishment of water reservoirs. Additional explorations of certain areas in the Aras River Valley might lead to the discovery of other species that could be expected to occur: *Lestes sponsa*, *Lestes virens*, *Platycnemis pennipes*, *Caliaeschna microstigma*, *Onychogomphus* (*forcipatus*) *albotibialis*, *Selysiothemis nigra*, or even as uncommon as *Stylurus ubadschii* and *Sympetrum arenicolor*.

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Additional information

Conflict of interest

The authors have declared that no competing interests exist.

Ethical statement

No ethical statement was reported.

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Author contributions

DK wrote the manuscript with support from KDK and CHS; DK conceived the original idea for the project; DK, KDK, KA, and GT documented Odonata in the field; DK prepared the flight period dataset and figures, with assistance from KDK; all co-authors contributed to and gave final approval of the manuscript.

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Data availability

All of the data that support the findings of this study are available in the main text or Supplementary Information.

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